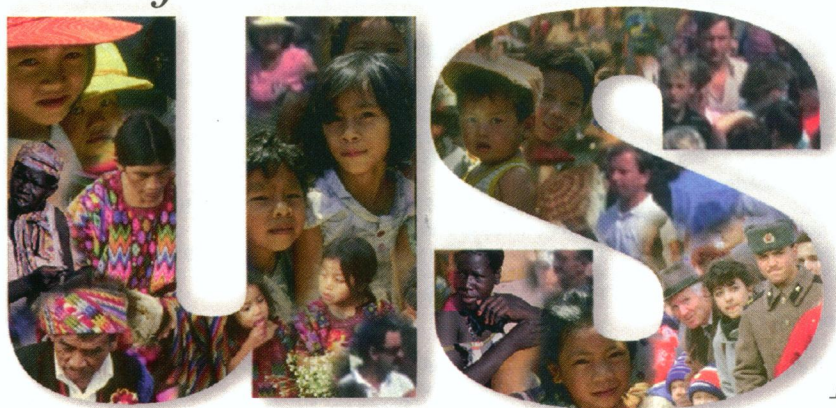


What More of



Means

When the first Europeans visited Easter Island in 1722, they found a barren land and exhausted people; 3,000 inhabitants were fighting for what remained of a lush and fertile Polynesian island. With their growing population quickly consuming its natural resources, the island's dense forests, rich soil, and abundant wildlife were nearly gone.

Today Easter Island has become a symbol of what could happen to the entire world if the human population continues to expand at its present rate. Just 200 years ago, the total world population hovered around one billion. By 1930, that number had doubled. Between 1950 and 1994, it more than doubled again, jumping from 2.6 billion to 5.7 billion, and 1 billion people are now added every 11 years. Since the mid-1800s, the world's population has quadrupled.

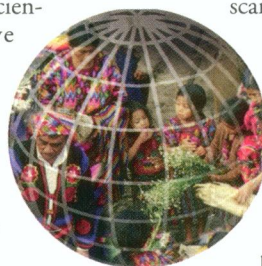
This astounding population growth comes on the heels of the industrial revolution and major innovations in technology and medicine. According to geographer and independent scholar Robert Kates, the present surge is one of three in human history: the first two coincided with the emergence of toolmaking and the spread of agriculture. "We are now in the last phase of the third major population surge, the completion of a demographic transition from a world with high rates of births and deaths to one with low rates," he wrote in the October 1994 issue of *Scientific American*.

Most of this century's population growth has taken place in the developing countries, not because of a sharp rise in birth rates, but rather a dramatic drop in the number of deaths, thanks in part to

victories over such common diseases as malaria, smallpox, and cholera—"nature's first line of defense against the expansion of *homo sapiens*," said Samuel Preston of the Population Studies Center at the University of Pennsylvania in a 1993 speech. Better living conditions, such as housing, nutrition, and sanitation, have also helped many more children survive.

Population vs. Environment

A major question now is the effect of this growing population on the environment that helped it develop in the first place. The search for answers to this question has become increasingly complex and controversial. The field of population and environment dynamics now includes demographers, ecologists, economists, physicists, biologists, anthropologists, geographers, nutritionists, and political scientists, many of whom have entered the debate in the last several years, introducing new sets of variables to ongoing research. In 1992, the National Academy of Sciences and Britain's Royal Society



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issued an unprecedented joint statement on the dangerous trends in population and environmental degradation. The Union of Concerned Scientists in Boston followed up that same year with a similar document.

"Demographers have also just entered the discussion in the last two or three years because decent data on both sides were not

available before," says Ronald R. Rindfuss, director of the Carolina Population Center in Chapel Hill, North Carolina. "And some of the sensationalism in the macrodebate had turned young scholars off. But now it seems the questions are starting to be better framed, so they're researchable in ways you can get a decent answer."

In general, ecologists and biologists tend to be pessimistic about the damage growing populations cause to the environment, based on their assumption that ecosystems have a limited "carrying capacity," or ability to support life. Eventually, they say, the environment will no longer be able to renew itself and will collapse. Economists, on the other hand, are often optimistic; they trust the free market and human ingenuity to develop new technology for coping with ever-larger numbers and scarce resources.

"But no science so far has been able to actually quantify the role of population on the environment," says Robert Engelman, director of the Population and Environment Program at Population Action International in Washington, DC. "At this point, there's no direct way to prove that, say, 80 million more people in a region had a particular impact on the water or air quality. However, it is clear that population is often the critical variable that can cause the degradation and even collapse of natural systems."

The pessimists in the debate often cite Reverend Thomas Robert Malthus, who predicted in 1798 that "the population growth rate would always promptly win a race against the rate of the growth of food, eventually leading to worldwide starvation," as well as "misery, vice, and premature death." His current followers, called Malthusians, have issued similar warnings,

Joseph Tart

such as Stanford University ecologist Paul Ehrlich's publication in 1968 of *The Population Bomb* and in 1990 of *The Population Explosion*. Ehrlich passionately argues that human numbers must diminish or they will trigger mass environmental destruction.

Even in the 18th century, Malthus had his opponents, notably the Marquis de Condorcet, who claimed the human mind would be able to remove all obstacles to human progress. Some experts today insist that the same ingenuity that created antibiotics and pesticides will help the world sustain its growing numbers and save it from an Easter Island-like fate. For example, University of Maryland economist Julian Simon has argued that ongoing advances in technology and science, such as genetic engineering and superefficient farming, will continue to guarantee the needs of future generations. Others believe that better resource management practices will enable heavily populated communities to thrive.

Any successful approach to solving environmental problems related to population growth must respect and incorporate these different points of view, according to Michael Brower, former director of research at the Union of Concerned Scientists. And over the past 10 years, the arguments have become increasingly subtle, says Sanjay Baliga, research analyst with the Program in Economics and Population at the World Resources Institute. "Because new subtleties are popping up all the time, we need the interaction between disciplines in order to more fully understand the issue," Baliga says.

Bad News and Good News

It is widely assumed that as populations grow, so will the pressure new generations exert on natural resources. The list of environmental problems aggravated by growing populations includes deforestation and desertification, loss of topsoil, poisoning of drinking water and pollution of oceans, shrinking wetlands, shortage of fuels such as firewood, exhaustion of oil reserves and of various mineral resources, siltation in rivers and estuaries, dropping water tables, erosion of the ozone layer, loss of species and wilderness areas, global warming, rising sea levels, nuclear waste, air pollution, and acid rain.

"In the past 10,000 years, since the dawn of agriculture, humans have deforested a net area the size of the continental U.S., mostly using it for cropland," writes Kates. "Water, in an amount greater than the contents of Lake Huron, is diverted every year from the hydrosphere for

human use. Half the ecosystems of the ice-free lands of the earth have been modified, managed, or utilized by people. The flows of materials and energy that are removed from their natural settings or synthesized now rival the flows of such materials within nature itself. And half of those changes happened within our lifetimes."

Any population increase often means putting more land under cultivation and raising the production per acre, steps that can require more capital, fertilizers, pesticides, and water irrigation. In the United States, almost all arable land is now under production, leading to soil erosion that averages 8 tons per acre per year, according to Cornell University ecologist David Pimentel. Eighty-five percent of water used in the United States is for agriculture, with the remainder for industrial and public use. Water consumption naturally rises with population growth, and the country's huge groundwater aquifers are disappearing. Parts of Texas and Arizona have already been pumped dry and can no longer be farmed, says Pimentel.

In addition, rapidly growing populations in Mexico, the Philippines, Indonesia, Brazil, and El Salvador have caused environmentally fragile lands to be overfarmed and depleted. The loss of natural habitats to more and more cropland, pastures, roads, and urban spread, Ehrlich warns, "reduces the biological diversity of plants and animals. Some of these natural biota are vital for recycling organic wastes, degrading chemical pollutants, and purifying water and soil." However, sophisticated farming techniques that increase the yield per acre and engineer plants to fend off predators show promise, argue the optimists.

"But water tables are quickly dropping in the developing world, especially in the Middle East and Africa," says Engelman. "The numbers of people there have risen beyond the water's ability to renew itself. And in Zambia, for example, population size has generally exceeded the forest's ability to regenerate. So the forest has stopped, and is now moving back."

In addition, while the world population was doubling between the 1950s and 1980, its commercial energy consumption



increased threefold. As a result of the higher demand, energy suppliers are mining more coal and building more dams and hydroelectric and nuclear power plants. The increased activity has led to higher levels of polluting emissions and waste.

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Levels of carbon dioxide and methane in the atmosphere are also tied to a region's population size. Some scientists propose the simple equation that twice as many people add twice as much carbon dioxide. With more than 20 million people, Mexico City has the largest population of any city in the world, and the worst air pollution. Demographers predict its population will grow to more than 30 million people, while Calcutta, Greater Bombay, Greater Cairo, Jakarta, and Seoul will reach 15–20 million each. In the United States alone, ever-increasing car driving and industrial activities now pump an estimated 23 million tons of sulfur dioxide into the atmosphere. The acid rain this chemical helps create then damages aquatic and forest life, often thousands of miles away from the source.

However, some experts argue that environmental problems are not solely a result of population size; rather, consumers in industrialized societies tend to have a much greater impact than those in less-developed communities. For example, the per capita emission of carbon dioxide in the United States is about 30 times larger than it is in India, according to Nathan

Population in the world's major regions, 1750-1995

Year	Population in millions (%)					
	Total	Europe and USSR	North America	Latin America ^a	Africa	Asia and Oceania
1750	694	144 (20.7)	1 (0.1)	10 (1.4)	100 (14.4)	439 (63.3)
1900	1,571	423 (26.9)	81 (5.2)	63 (4.0)	141 (9.0)	863 (54.9)
1950	2,520	549 ^b (21.8)	166 (6.6)	166 (6.6)	224 (8.9)	1,416 ^c (56.2)
1975	4,077	676 (16.6)	239 (5.9)	320 (7.8)	414 (10.2)	2,427 (59.5)
1995	5,716	727 (12.7)	293 (5.1)	482 (8.4)	728 (12.7)	3,487 (61.0)

^aIncludes Mexico, Central America, and South America.

^b1950 and later: excludes Asiatic republics of the former USSR.

^c1950 and later: includes Asiatic republics of the former USSR.

Keyfitz of the International Institute for Applied Systems Analysis in Austria. And as wealth increases, so can consumption, manufacturing, waste, and pressure on the environment. "Scenarios of likely future emissions of greenhouse gases are, of

In the past 10,000 years, humans have deforested a net area the size of the continental U.S.

course, dependent on the expected increase of the world population," Keyfitz said in a 1993 speech. "There is, however, no simple and straightforward relationship. The amount of energy being used by people very much depends on their economic status."

"How many people Earth can support depends in part on how many will wear cotton and how many polyester; on how many will eat meat and how many bean sprouts; on how many will want parks and how many will want parking lots," writes Joel E. Cohen, researcher in the Laboratory of Populations at Rockefeller University, in the July 21 issue of *Science*. "These choices will change in time and so will the number of people Earth can support," he said.

But a burgeoning population and greater wealth are not a guaranteed recipe for environmental disaster, according to Michael Mortimore, a research associate of the Overseas Development Institute in London. In an October 1994 article in *Environment* magazine, Mortimore and associate Mary Tiffen discussed a 60-year study of the resource management practices of Akamba farmers in the Machakos District in Kenya. Between 1932 and 1989, the district's population grew from 240,000 to 1,393,000. In the 1930s, analysts had predicted that rapid population growth, unreliable rainfall, frequent moisture stress, low soil fertility, and high erosion would most probably result in population-induced degradation on a large scale.

But over the decades, the farmers were introduced to a wide variety of farming techniques, including terracing, that were designed to conserve water, prevent soil erosion, and ensure an efficient system of nutrient cycling through plants, animals, and soil. They began to use manure on their crops, rather than inorganic fertilizers, as well as to feed their livestock in stalls instead of pastures, systematically cultivate their trees for firewood, and sell their produce.

"Increasing population density has had positive effects in Machakos," Mortimore

and Tiffen reported. "The increasing scarcity (and value) of land promoted investment, both in conservation and in yield-enhancing improvements. The Machakos study has shown that a high-density population in an area that is steep and dry can be sustained through—and perhaps be driven by—a combination of exogenous and endogenous practices and much local initiative."

In many regions, however, higher population densities do result in degraded living conditions, including entrenched poverty and limited access to food. Poverty in the developing world "will increase until nature itself curbs the human population with mass starvation," predicted Henry Kendall, MIT professor of physics and the 1990 Nobel Prize winner in physics, in an August 1993 issue of *Los Angeles Times Magazine*. Public health experts also view high population densities as ripe conditions for the breeding and spread of epidemics, bacterial and viral. For example, plagues often thrive in the most crowded conditions, where they are able to migrate quickly. Experts on global warming attribute rising temperatures to increased populations and human activity. Plus, higher air pollution levels can cause or aggravate asthma and other respiratory illnesses, while untreated and undertreated water spawns intestinal disorders and fatal diseases. And when food production must be increased, there is a greater risk of contamination from the increased amount of fertilizers and pesticides often required.

In recent years, high population densities and limited natural resources have been blamed for the outbreaks of war in some regions. With the highest fertility rate in the world, more than eight children for every woman, Rwanda's civil war has been partially blamed on rampant population growth. Tim Wirth, undersecretary of state for global affairs, said in a 1994 speech that environmental destruction is now an additional variable that can lead to war in troubled countries. "The nation's once rich agricultural land is so severely depleted and degraded that between 1980 and 1990, during a time of unprecedented population growth, food production fell by 20 percent," Wirth said of Rwanda. He also warned that Haiti's already high population of 7 million is

expected to double in the next 18 years.

When severe enough, environmental health problems begin to force a decline in population growth. For example, Russia's environment is one of the most severely damaged in the world today. Unchecked industrialization and a cynical disregard for environmental laws under communism have left a heavily polluted nation whose people struggle daily with poor air, water, and soil pollution problems. The price has been a 15% rise in infant mortality (only 40% of newborns are born healthy) and an average longevity of 57 years for males. Although there are many reasons for the population downturn, including alcoholism and the stresses of major political and economic upheaval, the main cause is ecological, said Alexei Yablokov, ecology and population adviser to President Boris Yeltsin. Russian scientists view the country's declining numbers as a national catastrophe.

No Easy Solutions

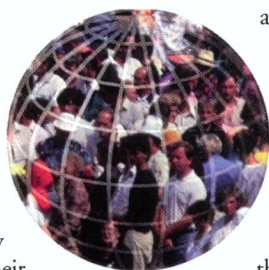
With around 1.2 billion people, China now boasts the world's largest population; India is second with nearly 1 billion. The United States, with more than 262 million inhabitants, is the fastest-growing industrialized nation. As an indicator of future growth, researchers often study a nation's total fertility rate (TFR), the average number of children a woman will bear in a lifetime. Italy has the lowest TFR, with 1.3 children, while West Africa's Mali has one of the highest, with 7.3. Family planning programs have brought India's TFR down to 3.4. Women in the United States today bear an average of two children each, a TFR of 2.0.

Twelve percent of the world's population resides in Africa, where the annual growth rate is 3%, according to H.W.O. Okoth-Ogendo, professor at the Centre for African Family Studies in Kenya. In a 1993 speech, Okoth-Ogendo noted that fertility management practices in Nigeria led to a drop

Decisions concerning family size are a very private matter and cannot be ruled without treading upon human rights.

in the TFR from an average of 8.1 in the period from 1969–1979 to 6.7 in 1985 and 5.4 in 1993.

Urbanized and industrialized nations tend toward smaller family sizes, while agrarian communities still prefer large fam-



ilies, in part because they depend on the labor. Social traditions can encourage high fertility rates in countries dominated by subsistence economies. Rural parents often view children as “productive assets” and as a source of security in their old age, wrote University of Cambridge economics professor Partha S. Dasgupta in the February 1995 issue of *Scientific American*. Parents need their children to help provide the family’s current and future income. But “the need for many hands can lead to a destructive situation,” such as “greater crowding and susceptibility to disease as well as to more pressure on environmental resources,” he adds. The key is to provide conditions that encourage couples to limit how many children they produce. By improving social and economic conditions, such as “providing cheap fuel and potable water,” the usefulness of extra hands will drop. “When a child becomes perceived as expensive, we may finally have a hope of dislodging the rapacious hold of high fertility rates,” said Dasgupta.

The process of finding solutions to the population problem is often politically and emotionally charged. Over the years, different countries have tried various methods to hold down their population growth. Some are controversial, including forced sterilization practices in some regions of India, and the one child per couple policy in China. In 1994, global delegates met in Cairo for the International Conference on Population and the Environment, where they considered alternative ways to lower national fertility rates. They discussed voluntary methods such as promoting modern contraceptives, encouraging economic development, improving infant and child mortality, raising the status of women through education and employment opportunities, and changing the attitudes of men toward women.

“Decisions concerning family size are a very private matter and cannot be ruled by laws or general regulations without treading upon the human rights ratified again and again in UN declarations,” said Keyfitz. “Wherever people have full repro-

ductive choice without coercion, they have chosen to have smaller families if opportunities to regulate fertility are available.”

“It’s better to stabilize the population, and not count on technology,” says Engelman. “But people don’t respond to coercion, so we have to give up the idea of population control. Instead, there is a pent-up demand for family planning and access to the right contraceptives. So if you combine relatively feasible things, such as access to education, with better access to medical care, you can dramatically change attitudes.”

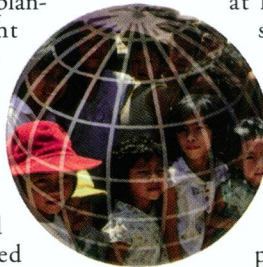
Like other government and private agencies, the United States Agency for International Development (USAID) has been working to fulfill the promises made at the 1993 population conference in Cairo. One strategy involves encouraging environmental organizations abroad “to think more about the connection between environment and population,” says Richard Cincotta, a fellow for the Western Consortium for Public Health at USAID. “It’s important to look at how environmental programs can be combined with family planning programs. For us, population/environment is a tool to raise awareness of the need for family planning.

“The problem is that it’s a long-term effort,” says Cincotta. “You have to collect enormous amounts of data and understand how the various population/environment models work in order to create effective policies. But in the meantime, policy makers tend to respond to presentations that are simple and even sensational, although in reality the question is often much more complex than you can ever convey in a policy presentation.”

Nevertheless, scientists continue to research, develop models, and try to quantify population effects on the environment. For example, the East-West Center in Hawaii began a project this year to help develop large-scale population and environment models, using a model developed

by the International Institute for Applied Systems Analysis which illustrates the relationships among population growth, economic growth, and environmental change. The East-West Center hopes to apply such modeling principles to the Cebu region in the Philippines.

“Such models have been around since at least 1975,” says Eric Jensen, senior fellow in the Program on Population at the East-West Center. “They always consist of a set of equations that describe a system of production and the way in which the environment serves as input and in turn is affected by output. But they can predict the effects only to the



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extent that the builders put them into the models. While some models may build in an extrapolation of current trends and predict catastrophe, others build in more realistic ameliorating impacts of society and economy and make less drastic predictions.”

In recent years, nongovernmental environmental organizations have also created or stepped up their population programs, including the Sierra Club, National Wildlife Federation, and the Natural Resources Defense Council. “We’re just starting to understand many things that weren’t looked at before, such as equity, how resources are distributed, and how that affects the way humans interact with their environment,” says Karen Kalla, director of the International Population Program at the Sierra Club. “There is a recognition now that the issue is not as simple as just looking at numbers. A lot of the recent changes are a result of there just being more of us, and of a much more complex world.”

Rebecca Clay